LANA Example 3 : Physical Prototype and Measurements
Explore The Linear-Algebraic Nodal Analysis (LANA) Algorithm
on a Circuit with 11 Resistors, 3 Voltage Sources, 2 Current Sources

LANA Example 3: Ideal schematic diagram

Figure 1 provides an ideal circuit diagram for an electric circuit that includes eleven 1kΩ resistors, three dc voltage sources, and two dc current sources. In this diagram, we label and enumerate each ideal circuit element and assign associated values.

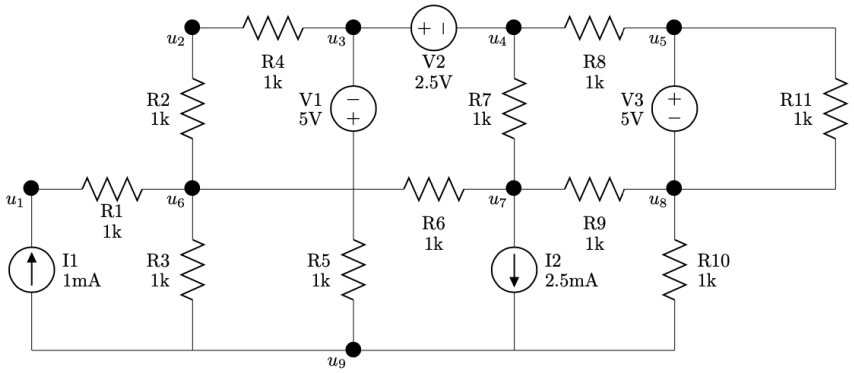

Figure 1: An ideal schematic diagram of a circuit containing eleven resistors, three dc voltage sources, and two dc current sources.

Example 3: Parts needed for this circuit

To build this circuit, we need the following parts:

- ☐ One half-size 2.2"x 3.4"solderless breadboard
- ☐ One orange 0.3" jumper wire
- ☐ One blue 0.6" jumper wire
- ☐ One gray 0.8" jumper wire
- ☐ Eleven 1k resistors (brn-brn-blk-blk-brn)
- ☐ Two 5V dc voltage sources (red and black wires out of the bottom of the source)
- ☐ One 2.5V dc voltage source (white and black wires out of the bottom of the source)
- ☐ One 2.5mA dc current source (red and black wires out of the side of the source)
- ☐ One 1.0mA dc current source (white and black wires out of the side of the source)
- ☐ Five fully-charged 9V batteries

Example 3: Get started with a picture of the physical circuit

In Figure 2, we see a photograph of the circuit we build in this example. For detailed instructions on how to built this circuit, see the bottom of this page under the "Example 2: Build this circuit" section.

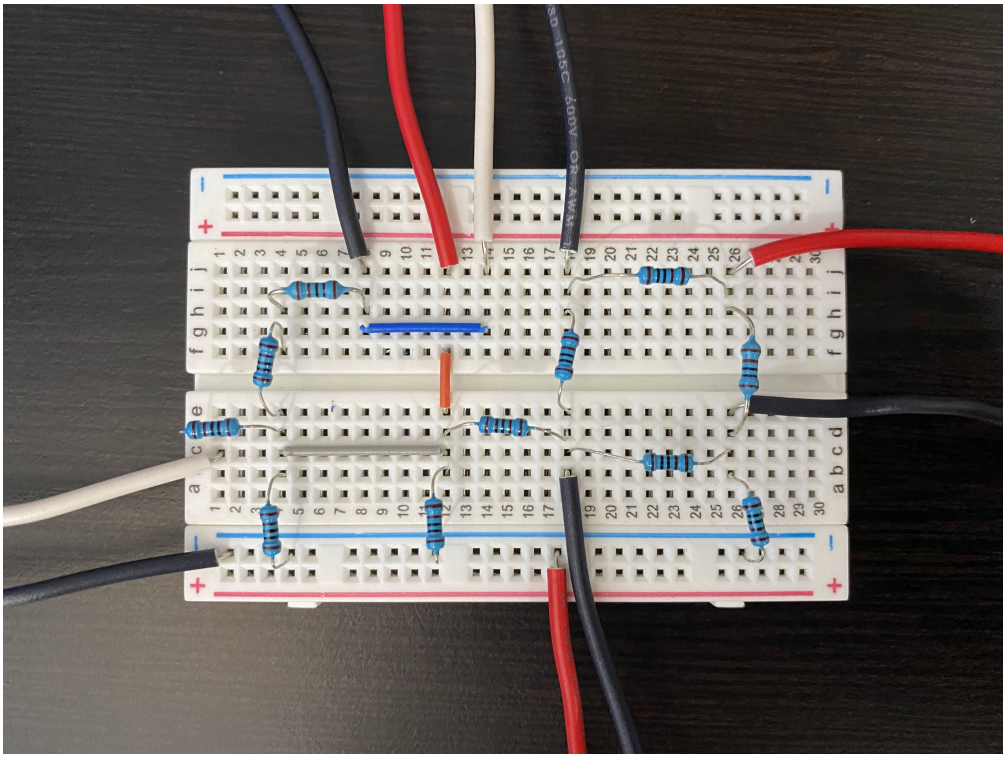

Figure 2: Photograph of the prototype for this LANA Example 3 circuit.

Example 3: Build this circuit

To build the circuit, please grab all the necessary parts described in the "Example 3: Parts needed for this circuit" section on the first page of this document. Then, follow the instructions below:

1. ☐ Disconnect batteries from dc sources
2. ☐ Insert blue 0.6" jumper across g8 and g14
3. ☐ Insert orange 0.3" jumper across e12 and f12
4. ☐ Insert gray 0.8" jumper across c4 and c12
5. ☐ Insert resistor r_1 across d1 and d4
6. ☐ Insert resistor r_2 across e4 and f4
7. ☐ Insert resistor r_3 across b4 and LN4
8. ☐ Insert resistor r_4 across h4 and h8
9. ☐ Insert resistor r_5 across b12 and LN10
10. ☐ Insert resistor r_6 across d12 and d18
11. ☐ Insert resistor r_7 across h18 and e18
12. ☐ Insert resistor r_8 across i18 and i26
13. ☐ Insert resistor r_9 across c18 and c26
14. ☐ Insert resistor r_{10} across b26 and LN22
15. ☐ Insert resistor r_{11} across h26 and d26
16. ☐ Insert red lead of v_{v_1} in j12 and blk lead in j8
17. ☐ Insert white lead of v_{v_2} in j14 and blk lead in j18
18. ☐ Insert red lead of v_{v_3} in j26 and blk lead in e26
19. ☐ Insert white lead of i_{i_1} in c1 and blk lead in LN1
20. ☐ Insert red lead of i_{i_2} in LN15 and blk lead in b18

Example 3: Measure Circuit Variables

In the table below, please write all the measurements you took for the fundamental circuit variables associated with the LANA Example 3 circuit. Notice that for each circuit element, we have two physical measurements.

LANA Example 3, Table I: Observed Circuit Variable Values

Circuit Element	Voltage Variable	Measured voltage (V)	Current Variable	Measured current (mA)
R1	v_{r_1}		i_{r_1}	
R2	v_{r_2}		i_{r_2}	
R3	v_{r_3}		i_{r_3}	
R4	v_{r_4}		i_{r_4}	
R5	v_{r_5}		i_{r_5}	
R6	v_{r_6}		i_{r_6}	
R7	v_{r_7}		i_{r_7}	
R8	v_{r_8}		i_{r_8}	
R9	v_{r_9}		i_{r_9}	
R10	$v_{r_{10}}$		$i_{r_{10}}$	
R11	$v_{r_{11}}$		$i_{r_{11}}$	
V1	v_{v_1}		i_{v_1}	
V2	v_{v_2}		i_{v_2}	
V3	v_{v_3}		i_{v_3}	
I1	v_{i_1}		i_{i_1}	
I2	v_{i_2}		i_{i_2}	

Example 3: Measure the node voltage potentials

Using the digital multimeter, please measure the voltage potential at each node of our LANA Example 3 circuit. We begin by connecting the negative lead of our multimeter to your chosen ground node. For the sake of this exploration, let's attach ground to node seven, since this is suggested in the ideal circuit diagram in Figure 1. Then, we connect the positive lead of the multimeter to each of the nodes, one by one, to capture the voltage measurement. In figure 3, we enumerate the node locations on for this circuit.

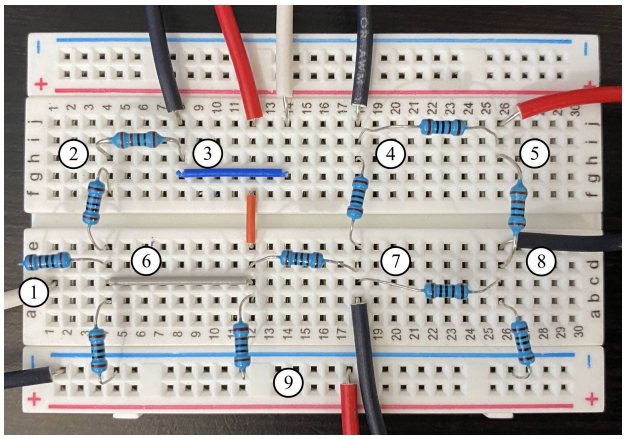

Figure 3: Nodes on Physical Circuit

Table 2:Node potential measurements

Node	Node Variable	Measured value (V)
1	u_1	
2	u_2	
3	u_3	
4	u_4	
5	u_5	
6	u_6	
7	u_7	
8	u_8	
9	u_9	